1:Stanford U. S-4, 5 1956 AF15 East China
AF15

133
731 in Shantung Province and in Honan Province to the west. These dikes stand 1.5-2.5 meters (3.5-8 ft.) above the highest known flood level. Another flood-diversion project, at the river mouth, has also been completed, and the Peking regime claims complete elimination of flood threat on this stretch of the Yellow River. The current is swift as it nears the ocean, and only above Lo-k'ou is it slow enough for river-junk traffic.[6]

Other rivers in Shantung Province are minor ones, except for the I River and the Shu River, which issue from T'ai-shan Mountain and flow southeast into Kiangsu Province. Major flood control and prevention work
• 503 has been done on these two rivers. The Yün-ho [Grand Canal] connects the Yellow River with a number of small lakes and cuts southeast to reach Hangchow in Chekiang. This man-made waterway, which is divided into several sections, changes direction wherever it meets a lake or another river.[7] The section of the canal which extends from Chen-chiang in Kiangsu to Hangchow in Chekiang is navigable for small steamers all year round; north of

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6. Ko Sui-ch'eng, Chung-kuo Ti-li Hsin-chih [New Geography of China], Shanghai, Chung-hua shu-chü, 1940, p. 67.

7. Ch'en Shih-chien, Chung-kuo Ti Ho-liu, [China's Rivers], Peking, San-lien ch'u-pan-she, 1950, pp. 67-72.

1:Stanford U. S-4, 5 1956 AF15 East China
AF15

503 Chen-chiang the canal is shallower.[8]

133 In the area between the Yellow River and the Yangtze River, the Hwai River is the main [311] source of irrigation. The Hwai River receives water from about a dozen radiating tributaries but, curiously, has no outlet to the sea. Since 1853, when the last change in the course of the Yellow River usurped the Hwai's channel and dammed the river's flow with silt, the Hwai has emptied into land-locked Hung-tse Lake. Because the lake was gradually filling up with silt, the water during a flood ran overland and inundated thousands of acres in the vicinity.[9]

503 The North Kiangsu Main Irrigation Canal, completed by the Peking regime, helps to reliev the Hwai of its high water pressure during the flood season. On the upper reaches of the Hwai a total of sixteen reservoirs are being built to divert flood water.

133 The Yangtze River flows into this region from the west. Its width is restricted to 1 kilometer (3,280 ft.) by the Huo-shan Range as far as Chiang-yin, where it widens to over 4 kilometers (3 mi.). The entire stretch of the

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8. Ch'u, Shao-t'ang, op. cit., p. 74.

9. In the 1950 flood, over 40 million mou of land were submerged; 13 million people were affected. Cf. Cheh Shin-chien, op. cit., p. 53.

2: Murphy G-4 (no date) 1953 AF15 East China AF18

of the river bed indicate an average of about one foot added overall to the elevation of the bed at the river's mouth in each twenty-year period, or about one mile added to the coastline in each sixty-year period.[1]

On this basis, the site of Shanghai would have been on the seacoast about 500 B.C., an empirical estimate which agrees with the record of Chinese history. All cities in the delta area east of the line of Sungchiang (map 5) for which there are adeqaute records were founded after the third century A.D.[2] Records of the Eastern Han dynasty (25 A.D. to 220 A.D.) speak of Kunshan, now 80 miles from the sea, as the seaport of Soochow in the second century A.D., but Shanghai has served as Soochow's port since about the fifth century A.D. Tsungming Island in the Yangtze estuary, according to the official gazetteer of the island, first emerged as a habitable sand spit in the tenth century A.D. By the thirteenth century it was sufficiently densely populated to be made a separate *hsien* (county), and at present measures approximately 43 by 8 miles.[3]

Building and Drainage

The material on which Shanghai rests is thus totally unconsolidated and presents serious problems for building. An average vertical section shows silt from the surface to about 20 feet, sand to 300 feet, and gravel mixed with sand and silt to about 1000 feet, where some consolidated conglomerate is reached. The water table lies between five and eight feet below the surface of the ground.[4] It may be assumed that before the draining and filling done by the foreigners since 1843, the water table was considerably higher, and that even before 1843 the canals dug by the Chinese provided enough drainage to keep the water table lower than it would otherwise have been considering the soil and elevation of the site.

Foreigners were discouraged to find in 1875 when a bridge was built across the mouth of Soochow Creek * that one blow from the small pile driver employed buried the pilings out of sight in the

* "Soochow Creek" is the name given by foreign residents to the Woosung Chiang, originally a much larger stream, which drains into the Whangpoo at Shanghai and connects the city with Soochow, some sixty miles inland. In the interests of clarity and consistency it will hereinafter be referred to as Soochow Creek, the name by which it has most generally been known in Shanghai itself.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

naturally built on the outside of the bend in the Whangpoo, where tidal scour cut a channel and where it could tap a larger hinterland than on the inside of the bend. It may be assumed that the Chinese city was originally at the junction of Soochow Creek and the Whangpoo, and that since its founding in approximately the fourth century A.D., deposition and alterations in the character of both Creek and River (see the next section of this chapter) have left the city on the Whangpoo about 5000 feet upstream from the Creek's mouth. A considerable area was thus left between the city walls and the mouth of Soochow Creek, and here the British Settlement was established.

Sir Henry Pottinger, head of the British delegation at the Treaty of Nanking, selected the site for the British Settlement at Shanghai on his way back from signing the Treaty, his choice being influenced by strategic considerations.[8] The area he fixed on was the little square bounded on three sides by defensible waterways and on the fourth by the navigable Whangpoo (map 6). The main suburbs of the Chinese city lay between its wall and the Yang Ching Pang, while north of this creek the land-use was agricultural.

The boundaries of the original British leasehold of 1843 and later additions, and of the original French leasehold of 1849, made close use of existing waterways. These were useful not only for demarcation and defense, but also for sewage disposal, drainage, and transport, although not for drinking since they were both brackish and polluted. Roads (including Nanking Road) were built over many of these streams, but they continued to act as sewers. The course of Defense Creek and its junctions suggest that it was canalized for at least part of its length and diverted to supply the moat of the Chinese city, supplementing the water also received from the three other creeks emptying into the moat.

There are no contemporary accounts of natural levees anywhere on this site in 1843, and the possibility of their existence is lessened by the contemporary pattern of streams and canals as it can be reconstructed from period maps and records. Possibly the material which must have been deposited by Soochow Creek and Whangpoo flood waters along their respective banks was continually removed by local farmers in order to spread the alluvium over their fields

2: Murphy G-4 (no date) 1958 AF15 East China AF15

133 (a common practice in the delta), c: :o maintain proper ground
361 levels for the flooding of rice paddies. It is therefore unlikely that foreign settlement was fixed in any respect by the protection or by the higher and drier ground which natural levees would have afforded.

648 A frontage on the navigable Whangpoo, completing the water defenses around the British Settlement, was an additional source of security for the foreigners, since it permitted British naval vessels to command the entire site with their guns. George Balfour, the first British consul at Shanghai, in expressing his approval of Pottinger's choice of a site, stressed the importance of the Whangpoo on this point: "By our ships our power can be seen, and if necessary, felt."[9] This consideration may have been a factor in the decision to retain the prohibition against building on the river side of the Bund, a problem which is discussed in more detail below. Certainly foreign naval vessels have been prominently anchored off the Bund at every period of Shanghai's history from 1843 until the Communist take-over in 1949.

● 503 Along the Whangpoo and Soochow Creek, the muddy tidal foreshore was not usable for buildings or wharves until embankments had been constructed. This process, known in all the China treaty ports by the Anglo-Indian term "bunding," was a continuing job requiring large sums of money. In the case of the famous Bund along the Whangpoo frontage of the International Settlement from Soochow Creek to the Yang Ching Pang, the terms of the original grant of lease rights by the Chinese government to British subjects prohibited building within thirty feet of the high-water mark, which space was to be reserved as a tow path for the use of Chinese trackers pulling boats upstream.

503 When the rights of the Chinese trackers lapsed by the mid-1850's
367 in the face of the growing foreign stake in Shanghai and the demands of steam navigation, the Shanghai Municipal Council inherited this waterfront strip by default and successfully defended it against the designs of foreign traders who wished to make commercial use of the area for warehouses and offices which would be convenient to the river.[10] The Council undertook the bunding of this strip in 1862, and in the process extended it beyond the high-water mark to

2: Murphy G-4 (no date) 1953 AF15 East China AF15

make an overall width more than double the original thirty feet. At the northern end of this embankment, at the mouth of Soochow Creek, the Council made use of some gratuitous real estate, deposited by the Creek around the hulk of a sailing ship wrecked there in 1851, and soon made part of the mainland by continued deposition, for the establishment of a park on the river side of the Bund. A broad boulevard was built from Soochow Creek to the Yang Ching Pang along the new embankment (later extended by the French into their Settlement), and this artificially preserved freeway has been maintained by the modern city as its chief showplace and promenade ground, lined to landward by hotels, banks, trading houses, and public buildings, but on the river side by unsightly floating wharves (necessitated by the annual tidal range of 13.6 feet) and mud flats exposed at low tide.

On this problem also the Communist administration of the city have expressed themselves in another project to dress up China's modern front door to the West. The current project for the Bund (now largely completed) calls for the removal of the railway and street car lines which have run down the middle of the broad embankment, with attendant rickshaw stands and cargo stations, and their replacement by an island to be planted with grass and trees, in a reversion to the original late nineteenth century pattern. Planting is also to be added on the river side of the Bund, to provide some screen in front of the harbor functions which are too important to move, however unsightly.

Water Supply

Water for drinking and for the manifold needs of a large city has been a perennial difficulty, since the brackish Whangpoo is high in carbonates and indifferently potable, while most local wells yield an even less desirable and more limited supply. Only the relatively modest demands of most of the Chinese population and the absence of any large pure-water consuming industries make the water supply adequate for such a large city on this site.

Until 1883 all water used by the foreigners for drinking (aside from that drawn from the few local wells) was dipped from the Whangpoo or Soochow Creek (and by the Chinese from the other

2: Murphy G-4 (no date) 1953 AF15 East China AF15

The Harbor

503 This is a delta city, and its consequent site problems are nowhere more apparent or more serious than in the matter of its harbor. The tidal inflow from the Yangtze which brings in relatively fresher water also brings in and deposits large amounts of silt. Shanghai maintains its position as a port fourteen miles from the Yangtze estuary only by constant dredging. Until approximately the eighth century A.D. Soochow Creek was the major stream at Shanghai and much larger than the Whangpoo, which up to that time remained about the same size as the present Soochow Creek.[13] However, mud brought in by the Yangtze and brought down by Soochow Creek from its upper course increasingly silted up the latter's lower reaches, and in 446 A.D. a canal was dug along its lower course in order to maintain the water link with Soochow, then the leading city of this part of the delta and at the time dependent on Shanghai as its port. Flood gates were also erected in Soochow Creek against the inflow of Yangtze mud. These are first mentioned in the thirteenth century, and were apparently replaced about 1735 by stone gates a quarter of a mile upstream from the Creek's mouth.[14] The gates had disappeared by the time the British arrived in 1842, but the Creek has remained navigable as far as Soochow for boats up to 80 tons cargo capacity.

As Soochow Creek lost its primacy, the Whangpoo became the master stream, possibly aided by capture of fresh headwaters, and with the additional help of tidal scour, cut a deep channel to the Yangtze. On the outside of the sharp bend in the Whangpoo at the mouth of Soochow Creek the currents maintained a depth adequate for sailing ships of the nineteenth century, and in 1842 there was a channel in the Whangpoo between Shanghai and the Yangtze estuary with a minimum navigable depth of about fifteen feet. By 1905 silting had reduced this to ten feet, and in that year dredging work was begun by the Whangpoo Conservancy Board, an organ of the Chinese Government staffed by foreigners and Chinese and administered by the Commissioner of Customs at Shanghai, also a foreign employee of the Chinese Government.

Three main bars had by this time formed: Woosung Outer Bar at the point where the Whangpoo empties into the Yangtze,

2: Murphy G-4 (no date) 1953 AF15 East China AF15

Woosung Inner Bar about half way between the mouth of the Whangpoo and Soochow Creek, and Wayside Bar, opposite the mouth of Soochow Creek. A Dutch hydraulic engineer worked as technical chief of the Board from 1905 to 1911, by which time a minimum navigable depth of 19 feet had been obtained between Woosung and Shanghai. Training walls were built at the mouth of the Whangpoo to concentrate the current and scour a channel. The old ship channel at Woosung Inner Bar (where a large island divided the river) was dammed and the river straightened at that point to permit maximum effective scour in the new channel. At Wayside Bar continuous dredging was instigated. This program, and the widening of the channel between Shanghai and Woosung to a least width of 900 feet was continued after 1911 under a Swedish engineer, Heidenstam, who published several short scientific papers based on his work with the river. By 1928 a controlling depth of 26 feet at neap low tide within the 900-foot channel had been obtained, but the daily tidal range of six feet made a 32-foot depth available for a few hours every day in the year.[16]

33,700,000 cubic yards of mud were removed by dredging between 1905 and 1930. About a third of this was used to fill in the old ship channel at Woosung Inner Bar. About half was dumped at sea, and the remainder was used for filling low-lying land adjacent to the river between Yangtzepoo and Woosung.[16] However the greatest obstacle to shipping using the port has been the Fairy Flats, a very large bar area at the entrance to the Yangtze estuary, where the silt deposition of the river is particularly concentrated as the delta grows seaward (map 5). Prior to 1932, when dredging work was begun there, ships drawing more than 26 feet were obliged to wait for high tide on every day of the year, those drawing 30 feet could arrive in Shanghai only at the time of spring tides, and those drawing 32 feet or more could not enter the harbor at all. While the deepest-draft ships regularly in the Pacific trade were the "Empress" boats of the Canadian Pacific Steamship Line drawing 31½ feet, the majority of trans-Pacific shipping entering the harbor drew between 26 and 30 feet and were thus frequently delayed by as much as a day at the Fairy Flats. This condition also caused considerable congestion in the harbor. Turn-arounds were slowed and money was lost.[17]

2: Murphy G-4 (no date) 1953 AF15 East China AF15

503 Work was begun in 1932 by the Board on cutting a channel of 33 feet at mean high tide through the Fairy Flats, which required the removal of nine feet of silt from the bar as it then existed, including an allowance of three feet for clearance in heavy seas and one foot for fall of the tide during the passage of the ship. By 1936 about three of the nine feet had been removed for half of the distance of the channel. Dredging was suspended during the Japanese occupation and has not yet been resumed during the blockade conditions of the post-war period. Much of the earlier work has thus been lost.

[133] 502 Ebb and flow currents at Shanghai average about three knots for a total of eight hours during each 24-hour period. Six major bends in the Whangpoo (the one at the mouth of Soochow Creek being almost a hairpin turn) and the narrowness of the channel make these tidal currents a problem for ocean-going ships, both in docking and in maneuvering for anchorage. None of the ocean vessels (except for foreign warships, which usually anchored off the Bund) dock above Soochow Creek, and most of them find it easier to unload cargo onto lighters in midstream, taking on cargo at wharves 505 farther down the river in Yangtzepoo.* The wharves along the Bund are used for lighters and for river shipping. Roadsteads within the harbor are severely limited, and collisions and congestion are common.

There have been periodic suggestions that the main harbor be moved to Woosung, but even here conditions are far from ideal. There is a large anchorage in the open roads of the Yangtze with a minimum depth of 30 feet at mean low tide, measuring two miles by six miles, but tidal currents average about a knot stronger than at Shanghai, and these together with the winds across the open sweep of water prevent loading or unloading by lighter about 30 per cent of the time. Existing wharves at Woosung can accommodate only vessels drawing less than 18 feet. Cargo unloaded at Woosung by lighter or at the wharves is mainly carried to Shanghai directly by lighter on the Whangpoo, but there is also some shipment by rail.

The expense and inconvenience of transshipment would probably

* Because of the angle and direction of the tidal currents and the set of the channel, loaded ships can be maneuvered out of the wharves and down the Whangpoo more easily than up the river and into the wharves.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

or seventh in rank among world ports, in terms of annual net registered tonnage entered and cleared, points to its characteristic role as a delta port. The trade of the Yangtze basin requires a major outlet to the sea, and Shanghai, despite its poor site, offers the only practicable deep-water harbor near the mouth of China's greatest trade highway, the Yangtze River.

The harbor has a few advantages. At latitude 31° 10′ and where it is also influenced to some extent by the warm Kuroshio, or Japan Current, Shanghai is the northernmost port on the China coast to be free from ice at all seasons in most years. This gives it an advantage over the two leading ports of north China, Tsingtao and Tientsin, where floating ice is usual for parts of January and February. Location fourteen miles up the Whangpoo gives the harbor protection from typhoons, which are a significant menace to shipping in all south China ports during late summer. Shanghai averages about one typhoon annually, but with the adequate warning provided and the degree of protection afforded by its up-river location, damage to shipping is never more than negligible. In the period before the growth of the foreign city, this inland location was also important as a measure of protection against frequent coastal raids by Japanese and Formosan pirates. Finally, fog adequate to delay shipping in the harbor or in the approaches in the Yangtze estuary is quite infrequent.

Prophecies of Shanghai's isolation from maritime shipping by the seaward growth of the delta have not been lacking at any period in the history of the modern city. As each new difficulty arose however, means were found to overcome it, for the advantages of the city's location have greatly outweighed the disadvantages of its site and have made extensive dredging worthwhile. There is no reason to believe that the undoubted accumulation of silt, especially on the Fairy Flats, during the war and post-war years will present an insuperable problem once dredging is resumed. The great volume of water discharged by the Yangtze into the sea and the scouring action of tidal currents will assure some kind of channel in the estuary on which dredging can concentrate. The neglect of dredging over such a long period may make it necessary to relocate the main ship channel, but what dredging has accomplished before it can accomplish

2: Murphy G-4 (no date) 1953 AF15 East China AF15

gain. As long as water transport retains its basic place in the Chinese economy, a harbor for ocean ships will be maintained at Shanghai as the commercial center of the Yangtze basin.

Relief and Climate

The site has only two advantages of importance: it is almost completely flat, and it has a more favorable climate than rival south China ports. Ample level ground was useful during the purely commercial phase of the city's development in allowing adequate space for storage of goods, for half of China's foreign trade passed through Shanghai from 1865 on, but it was more important in allowing the development of manufacturing after 1895. The commercial center which began in an area of 43 acres along the Whangpoo in 1843, demarcated and defended by creeks, was able to grow outward toward the west, south, and north as both political and economic conditions provided the impetus for metropolitan industrial development. Level ground continues unbroken within a twenty-mile radius of the city. While the site's liability to floods is a notable disadvantage, level ground must in general be counted an asset, especially as against the lack of it in Hong Kong, Foochow, Amoy, and other south China ports.

Shanghai's climate is influenced alternately by cold dry air from inner Asia and Siberia, and by warm moist Pacific air; it is tropical for one third of the year and temperate for two thirds. Rainfall averages 45 inches annually, 14 inches of which falls in June and July, but with no very marked seasonal concentration. July and August are uncomfortably tropical, and while rains keep the temperature below 90° for at least a quarter of these two months, the relative humidity throughout this period averages 84 per cent. Temperatures rarely exceed 98°. Vital statistics for foreign residents of the China treaty ports included in the yearly medical reports published since 1870 by the Maritime Customs give Shanghai, with a death rate averaging 16 per thousand annually for the period 1870–1930, a relatively good record. Most of the foreign residents considered it among the healthier treaty ports despite its uncomfortable summer, during which as many of them as were able left the city for the central mountain belt or the Shantung beaches. The accompanying table com-

2: Murphy G-4 (no date) 1953 AF15 East China AF15

505 drawing fifteen feet and for the same distance at low water for vessels drawing six feet. Smaller steam launches use the river for about 700 miles at all seasons. The Hsi system, however, drains only about 210,000 square miles, and contains no such extensive lowland as the Yangtze basin (map 2).

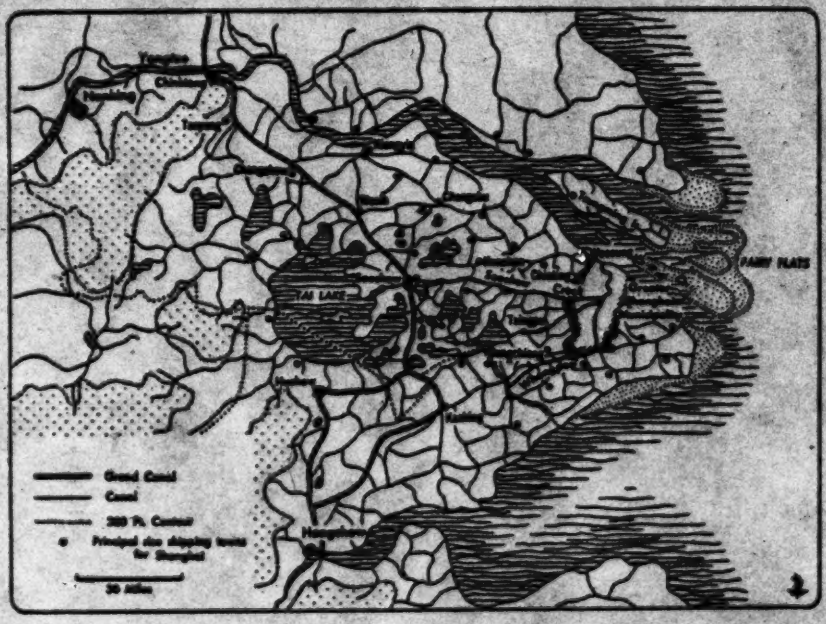
On the Yangtze there is an all-year ship channel for 5,000-ton ships as far as Hankow, 600 miles from the river's mouth, and a summer (high-water period) channel to Hankow for 10,000-ton ships. Above Hankow, permanent steamship service is maintained as far as Chungking, 1400 miles from the sea, by vessels up to 2,000-tons, and river steamers also operate to Suifu (Ipin, Süchow), 150 miles farther upstream where the Yangtze leaves the mountain mass of central Asia and is joined by its navigable tributary, the Min, from the western part of the Red Basin of Szechuan. Map 4 shows the extent to which the river's tributaries are navigable by different sized ships (Suifu on this map is referred to as Süchow). The total of inland waterways navigable from Shanghai by junks at all seasons (excluding the canals of the delta) is nearly 30,000 miles, reaching approxi-
439 mately 200,000,000 people. This transport network is reflected in the fact that Shanghai between 1865 and 1936 handled between 45 and 65 per cent of the total foreign trade of China by value.

● 503 505 The Yangtze system feeding Shanghai is reproduced in miniature within the delta itself (map 5). A maze of canals dissects the fertile triangle, connecting with natural waterways to form through water links between every village and town in this area and from
[312] all of them to Shanghai. The canals are used primarily for transport, but they also serve as sources of irrigation water for wet paddies and as community water supplies, in addition to providing drainage, which may have been their original purpose.[2] The alteration of the natural environment which the canals represent has been in progress for at least the last 2,000 years, and now constitutes probably the largest concentration of artificial waterways anywhere in the world.

When the canals are added to Tai Lake and the chain of smaller lakes to its east, the Yangtze, the Whangpoo, Soochow Creek, and many smaller rivers in this area, the landscape becomes an enormously magnified Venice. Within a radius of at least 100 miles from Shanghai it is possible to go from any village or town to any other

2: Murphy G-4 (no date) 1953 AF15 East China AF15

village or town entirely by water, and in most cases in no other way. According to existing estimates,[8] and on the basis of the incomplete cartographic data, the delta area must contain at least half a million miles of canalized or artificial waterways. The railway between Shanghai and Nanking includes in its 193 miles 164 bridges over navigable rivers or canals.



Map 5. Waterways of the Yangtze Delta. All waterways shown are navigable. Provincial boundaries are indicated by a dotted line.

The use of water routes is reflected in the sparseness of roads compared with other level areas of China and in the fact that such roads as exist run in most cases at right angles to major waterways. In addition, carts and barrows are scarce in the Yangtze delta, in marked contrast with other areas of China, or with most pre-industrial regions. Traditional Chinese bridges in the delta area are nearly all of the single span hump-backed type, reflecting the virtual absence of wheeled traffic as well as the need to provide adequate clearance over waterways for the passage of masted vessels.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

The port of Hong Kong however owes its ascendancy as much to its political status as to its physical advantages. Acquired by the Treaty of Nanking in 1842 at the close of the first Anglo-Chinese war as a British rival to the Chinese-controlled trade at Canton, it has since its founding served as an entrepôt for the entire China coast. Since at least 1865 it has transshipped annually between 20 and 25 per cent of China's total foreign trade by value, aided by its treaty status as a free port.* Hong Kong has nevertheless yielded first place as a port to the greatly inferior harbor of Shanghai, located on the mainland and more closely oriented to China's productive areas and transport routes.

The coastline becomes emergent at about the mouth of the Chientang River in Hangchow Bay. There is only one natural harbor on the coast north of Hangchow used regularly by a large volume of ocean shipping: Tsingtao, on the rocky promontory of Shantung. Chefoo, also on this promontory, has a good, though somewhat shallow, natural harbor, but it has been relatively little used or improved. Weihaiwei, near the tip of Shantung and thus one of the most seaward ports in China, is a largely artificial harbor constructed by the British at the turn of the century for their naval vessels (following a decade of "concessions" by the crumbling Ch'ing government to the European powers), but its large protected roadstead has attracted little commercial shipping.

It is an unfortunate circumstance that these few adequate harbors are in effect isolated from the body of north China by the crystalline mountains of Shantung and by their out-of-the-way location. This situation is responsible for the small importance of Chefoo and Weihaiwei as ports, as well as for the fact that they still have no railway connections. Shantung, originally an island in the Yellow Sea, has been land-linked by silt deposition from the Huang, yet its harbors are economically cut off from the mainland. In a more highly industrialized economy, these harbors would probably be more important, but the almost complete lack of water transport links between them and the north China hinterland decrees for them under present conditions a relatively minor role.

Tientsin, the leading port of north China, forty miles from the sea on the Pei River, fight a losing battle against silt. Two rivers flow-

* Hong Kong is not included in the customs figures for China.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

503 ing from the semi-arid plain of north China, navigable for small boats only with difficulty during the summer and autumn, and subject to severe spring floods, feed into the Pei just above Tientsin. The combined deposition of all three has forced the removal of the port from Tientsin itself to Taku, at the mouth of the Pei, where an offshore bar is forming with a minimum navigable depth at mean low tide in 1936 of fifteen feet. Dredging there is barely able to keep pace with deposition, and the open roadstead at Taku affords inadequate protection to shipping. Ships drawing over fifteen feet discharge cargo onto lighters six miles out at sea.

During their occupation of north China, the Japanese began work on a new artificial harbor just south of Tangku (map 1) on an ambitious plan which remained largely unfinished with the end of the war in 1945. This work has now been resumed by the Communist Government of China, which aims to complete the project in 1953. The harbor, to be known as Hsinkang ("new port"), is planned to receive vessels up to 10,000 tons, which will be able to discharge their cargoes onto wharf-side railway lines. The total protected roadstead will be about ten square miles, but its projected depth would still exclude the largest trans-Pacific carriers.[5]

504 Haichow, in northern Kiangsu, terminus of the east-west Lunghai railway, is an artificial harbor nine miles from the sea. Work was begun on dredging the small river which connects it with the sea, and on the building of wharves, in 1933, and by 1936 the port could handle ships drawing up to fourteen feet. It thus remained largely limited to the coasting trade. Coaling facilities are available on the coast just south of the river's mouth where a group of islands provides some shelter, but again controlling depths exclude most large transocean shipping. Peking, without access to navigable waterways (aside from the Grand Canal, which contains several unnavigable stretches in Shantung and southern Hopeh) has relied on Tientsin (Taku) as its port. Primarily an administrative center and rail junction, Peking's population had not reached a million and a half by 1936.

The configuration and relief of north China make it difficult for any one deep-water port to serve it all. As it is, while Tientsin (Taku) acts as the port for most of north China, a considerable proportion

2: Murphy G-4 (no date) 1953 AF15 East China AF15

442 439 to keep healthy in China, and nearly every foreigner in Shanghai rode, hiked, or took part in team sports.

The Chinese were amazed at this waste of calories. "'Belong foreign man custom' they would say as they turned to their diet of rice and cabbages," according to the memoirs of an early foreign resident.[22] Certainly the foreigners ate well, but while they brought spirits and special foods from home at great expense, the bulk of their food came from the delta area, according to the records of the same early resident, who was for a time during the 1870's in charge of the mess at one of the foreign firms and lists the sources and prices of the most important items which supplied it.[23] Foreign merchants and assistants would often be gone for weeks at a time on shooting excursions in the hinterland. Wherever they wanted to go in the delta area they found they could travel by houseboat, to the smallest village or the most remote bird-feeding grounds. And wherever they went they found these waterways clogged with Chinese craft carrying both domestic and foreign goods to and from Shanghai.[24]

509 W. H. Medhurst, an early British missionary (and later consul) at Shanghai, took a trip into the tea and silk districts of Kiangnu, Chekiang, Anhwei, and Kiangsi in 1845, disguised as a Chinese. His account of the trip laid emphasis on the waterways of this region, and since his journey never took him far from the waterways of the delta or of the Yangtze system, he attributed what he saw over this large area to the whole of China:

> Canals have been dug in all directions, and spread like veins and arteries to almost every part of the empire. As far as the experience of this writer goes, the Chinese have no walled cities or large towns except in places which are accessible by water.[25]

[491] He noted that the major canals, used by grain junks, averaged about 40 feet wide and 6 to 8 feet deep, and that bridges over them were at least 20 feet above the surface of the water at the center of the arch so that the grain junks could pass under them with their masts lowered.

361 By 1863, the original foreign leasehold at Shanghai of 43 acres had been expanded through agreements with the taotai to a total of

2: Murphy G-4 (no date) 1953 AF15 East China AF15

2094 acres (including the French Settlement), and Shanghai was indisputably the leading port and commercial city of China.

Struggles with the Harbor

The problem of an adequate harbor, however, was a matter of increasing concern to the foreign community through the latter half of the nineteenth century, if not to the Chinese authorities. It was openly stated by the ranking Chinese government official at Shanghai in 1874 that Woosung Outer Bar was in fact a "heaven-sent barrier intended to prevent war vessels of heavy draught . . . from entering the harbour."[26] But foreign residents realized with alarm that the city could not hope to remain an ocean port if the silting process were allowed to continue, and they had yearly evidence of the speed with which the Yangtze was extending its delta. Blonde Shoal, near the mouth of the Whangpoo, was covered with ten feet of water at low tide in 1850, and by 1890 rose three feet above mean low water. The history of Tsungming Island, already referred to above, was well known, as well as the fact that the site of Shanghai had originally been on the seacoast and that it was rapidly being cut off from access to the sea.

A local resident writing in 1894 estimated that silt deposition in the Yangtze estuary would lessen the depth of the water about one foot in every eight years if spread evenly, and that while tides and currents provided some scour in certain channels, these too were filling up, although at a slower rate. The same writer, however, pointed a lesson later acted on by the Whangpoo Conservancy Board after 1905 by calling attention to the fact that when a small coasting vessel had been rammed and sunk in mid-stream just above Woosung Outer Bar in 1892, the Whangpoo current had apparently been diverted and concentrated sufficiently to scour a new and deeper channel through the bar.[27]

Shanghai's environmental dilemma was intensified by the progress of steam navigation in the latter half of the nineteenth century. The most economical ocean carriers were increasingly those of larger draught, and by 1885 or 1890, most of these new steam freighters could reach Shanghai only with difficulty or not at all. Shipping lists published in the *North China Herald* at Shanghai

2: Murphy G-4 (no date) 1953 AF15 East China AF15

show an average size of ocean-going ships entering Shanghai harbor between 1850 and 1860 of about 1,000 gross tons. In the decade of the 1860's, this figure reached 2,300, and by 1880 had exceeded 4,000. The original harbor regulations, published by the *North China Herald* in 1852, limited the overall length of ships to 165 feet if they wanted to come as far as Soochow Creek, in view of the narrow channel and confined anchorage. However, between 1850 and 1930 the width of the river at Shanghai decreased from about 2300 feet to 1450 feet, and while dredging had widened somewhat the original channel and anchorage by 1930, the harbor was little more commodious than it had been in 1850.[28] The advent of steam did however make the harbor's overall size and the narrowness of the channel less of a disadvantage than it had been for sailing ships, and it further removed the special advantage of Canton accruing from the monsoon winds.

As early as 1873, representatives of the major foreign shipping firms in Shanghai pointed out to Robert Hart, Inspector General of Customs, the need for dredging the Inner and Outer Woosung bars. Hart approached the Chinese authorities, but could not persuade them to take any action. In the following year, the British chairman of the Shanghai General Chamber of Commerce, in a letter to the British Minister to China, T. F. Wade, asked whether permission might not be obtained for the foreign ratepayers of Shanghai to tax native and foreign shipping in order to dredge the harbor if the Chinese government refused to do anything about it, but Wade also had no success through Peking channels.[29]

As a result of this controversy, Hart in 1875 published his opinion on the problems raised by the vanishing ship-channel, which read in part as follows:

> The trade consequent on opening the Yangtze basin has so far been diverted into a false channel by the vested rights or money spent in Shanghai. The agency is in turn counteracted by the opening of the Suez Canal, through which steamers have begun to pass, making London and Hankow their termini . . . Teas will be shipped at Hankow and Kiukiang, and Shanghai silks and Ningpo teas at Chinkiang. They will be the return cargoes of the steamers which carry what China will continue to demand from Europe. In twenty years' time Chinkiang will

2- Murphy G-4 (no date) 1953 AF15 East China AF15

503
487

have taken the place of Shanghai as a semiterminus and transshipment port . . . Thus looked at, as it affects and is affected by natural and artificial agencies now at work at the mouth of the Yangtze, the question of the Woosung Bars is seen to mean that dredging may possibly be nothing more than a means of making the last days of Shanghai a little more comfortable than they would otherwise be; it will not prolong or avert the commercial death of the place, but it will make a show of vitality during its declining years more possible . . . Given the natural and commercial agencies at work, it may be taken for granted that, certainly for ten, or perhaps twenty or thirty years to come, the commercial status and foreign community of Shanghai will be such as to make it worthwhile to prevent the river from being blocked up at any one point, for instance by the Woosung Bars. Dredging can do this, and then only for a time. It cannot secure for Shanghai either a navigable channel or a continuance of commercial prosperity . . . The circumstances of Shanghai, its present position as a commercial centre, the interests of the community and the revenue it yields China, are in themselves sufficient reasons why the demand for dredging ought to be assented to, but it must be borne in mind that no one can say how soon commerce may cease to ask for access to Shanghai, or natural forces acting elsewhere make dredging operations at Woosung useless.[20]

Hart could not of course foresee the degree of improvement in dredging methods and machinery which have kept Shanghai, as well as many other world ports, open to ocean commerce where natural processes would long ago have cut them off or where the dredging equipment of 1875 would have been unequal to the task. He also failed to appreciate that the locational advantages of Shanghai were sufficiently great in relation to other possible centers in the Yangtze basin to make large-scale efforts to combat the disadvantages of its site worthwhile, or to permit its continuance as a major port despite its poor harbor. He may have been influenced in his judgment by the fact that in 1875 the only three trade commodities of importance were opium, tea, and silk. These high unit-value goods were relatively less dependent than bulk or low unit-value goods on precise locational advantages in their transport. As they lost their dominant position in the foreign trade of China, the more diversified and relatively lower unit-value agricultural exports and the equally diversified and low unit-value imports created

2: Murphy G-4 (no date) 1953 AF15 East China AF15

a much greater need for an ocean port with the best possible location. Shanghai's water route connections through the Yangtze system made it the obvious choice.

Hart also did not consider the fact that while the progressive rise in average tonnage of ships in the Pacific trade increasingly emphasized the limitations of Shanghai, it even more pointedly revealed the barriers to navigation on the Yangtze above Shanghai. Chinkiang, Hart's choice as the port most likely to become the major Yangtze basin entrepôt, declined to insignificance in ocean shipping handled by the turn of the century. On the other hand, within twenty years of Hart's prophecy, and while he was still Inspector General of Customs, the gross value of the trade of Shanghai doubled.

As the foreigners continued to see new mud banks rise out of the Yangtze and the Whangpoo, dry out, and be settled and farmed, other gloomy predictions were added to Hart's.[31] Partly as a result of indirect foreign pressure, the Chinese Government purchased a German dredge and began work on the Woosung Outer Bar in 1881, but little was accomplished and work was stopped in 1889. By 1893, the situation led the foreign Commissioner of Customs at Shanghai to remark:

> The Woosung Bar dredging has I think convinced most people that the bar there must always be with us and that business must adapt itself to things as they are . . . The largest vessels which come to port never come any nearer than Woosung. I expect to see development of business there, but the available anchorage is not too capacious, and the distance from go-down is a considerable source of expense.[32]

In addition to the factors mentioned here by the Commissioner, the presence of the Fairy Flats in the Yangtze estuary is probably as much responsible as the progress of dredging in the Whangpoo for the fact that Woosung has never become Shanghai's port in any significant respect.

With the beginning of permanent dredging operations on a large scale by the Whangpoo Conservancy Board in 1905 (see above, Chapter Three), the locational virtues of Shanghai in effect dictated an ultimately successful attack on the city's major site problem.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

503 Once Western economic enterprise had established itself at this strategic center of modern China's key economic area, neither treaties nor Chinese officials, neither isolation nor mud, could prevent Shanghai from realizing its wider geographic advantages.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

fields growing other crops (primarily cotton), since this entails a thorough turning over of the soil which crop rotation alone would not accomplish. When the exchange is completed, the new surfaces are then overlaid with an average per acre of 70 tons of mud dug from the canals. Maintenance of navigability in the canals is a communal responsibility, and farmers are recompensed for their dredging labor by using the highly fertile calcareous mud (which as a rule has supported a heavy growth of water weeds as well as ultimately receiving considerable farm and village waste), also by making use of the canals to market their production and receive goods from outside.[4]

The farms are small, 93 per cent of them under 50 *mow* and 25 per cent under 5 *mow*, with an average size of 34 *mow*, according to a Chinese statistical study[5] (one *mow* equals approximately one sixth of an acre). Their cultivation is better described as gardening than as farming. Tools in general use are limited to the *t'u t'ou* (earth head)—a large-bladed hoe—and smaller metal-headed rakes, hoes, and mattocks, all designed for painstaking hand labor. Water is transferred from the canals to fields for irrigation by means of endless chains of small buckets mounted on inclined frames and driven by foot treadles.[6] The average number of total animal units per farm is lower in this area, according to Buck, than anywhere else in China[7] This is due to the small size of the farms, and to the abundance of human labor, which cannot afford to allocate feed for animals in return for the labor, meat, and manure which they produce. Manual gardening gives a greater return than animal husbandry or farming with draft animals from this fertile and repeatedly refertilized soil in proportion to the food it consumes, and permits a population of 40 million people in the fertile triangle.

With such intensive cultivation, crop yields in the fertile triangle are among the highest in China. Buck's samplings show both rice and wheat yields in this area consistently among the upper five per cent of rice and wheat yields for the 161 localities in China covered by his study.[8] Within a thirty-mile radius of Shanghai, where the city's night soil is cheaper and more readily available than in outlying districts (see below, pp. 162–64), yields of all crops are exceeded by only two counties in China (both near Canton)

2: Murphy G-4 (no date) 1953 AF15 East China AF15

433 areas of Asia are all deltas, and all are of the same order of population density as the Yangtze delta: the lower basins of the Mekong, Menam, and Irrawaddy Rivers. Each of these deltas also contains a primate city, and in addition produces most of the rice for the entire population of each country (Indo-China, Siam, and Burma respectively). Yet each of them has continued, under peace-time conditions, to produce large yearly surpluses of rice for export.

503 The Sui emperor Yang Ti (A.D. 605–618) first joined together
433 existing natural and artificial waterways into a connected system running from Hangchow in the south to northern Kiangsu and thence westward across Honan to the Sui capital at Ch'angan (modern Sian). This system of waterways linking the rich rice areas of the delta with the military and political centers of the north included several branches, among them a route to the Peking area which was later incorporated in the Grand Canal of the Mongols.* The southern half of the present Grand Canal was completed from Hangchow to Kaifeng during the northern Sung dynasty (A.D. 960–1127), *inter alia*, to bring rice for the supply of the court and capital at Kaifeng. During the Yüan (Mongol) dynasty (1260–1368) the canal was extended from Kaifeng to Peking, the Yüan capital, and up to the time of the late Ch'ing dynasty (1644–1911), with its capital also at Peking, rice to feed successive imperial centers in arid north China flowed in great volume out of the productive Yangtze delta.

433 Apparently a local surplus existed throughout this period, but it was not allowed to accumulate locally as the basis for a new population growth in the delta. By a coincidence which may or may not be significant, the end of the imperial system (the revolutionary Kuomintang overthrew the Ch'ing Government in 1911, and established its capital in 1927 at Nanking) came at about the beginning of Shanghai's major population growth (graph 1). It is certainly possible that instead of going to Peking, the delta rice

* Chi Ch'ao-ting, *Key Economic Areas in Chinese History* (1936), pp. 114–115, in giving an account of this development and its later extensions, shows that canals between the Huai and the Huang were built at least as early as the fifth century B.C., and that a through water route between the Yangtze delta and western Honan apparently existed by the third century B.C.

2: Murphy G-4 (no date) 1953 AF15 East China AF15

439 316 Consular and Customs reports from Shanghai during the early decades of the modern city show that it depended almost entirely on overseas imports of coal. There was a large movement in ballast from England to Shanghai from the opening of the port to foreign trade in 1843 through the period of the 1860's, when foreign merchants had difficulty finding a market for foreign goods in return for China's tea and silk.[43] It was consumed largely by the coastal, river, and ocean vessels fueling at Shanghai.[44] This relatively cheap ballast coal from England was however gradually replaced after 1870 by even cheaper coal from Nagasaki in Japan and from the large Chinese government-operated Keelung mines (subsequently taken over by the Japanese in their conquest of Formosa in 1895) at the northern tip of Formosa, opened in 1875. Both of these new sources were on tidewater and coal from both could move to Shanghai as part of the growing volume of east Asian maritime trade.

316 438 The first large-scale coal mine in China was opened at Kaiping, Hopeh, in 1878,* (map 9), and the first shipment from Kaiping to Shanghai arrived in 1881, but this coal was unable to compete with Japanese imports at Shanghai until after the turn of the century. By 1930, the Kaiping mine accounted for 23 per cent of China's annual coal production.[45] Kaiping was connected by rail to Tangku and Tientsin in 1888 (the first permanent railway in China), and to Shanhaikuan, via Chingwantao, in 1894. At Chingwantao, 79 miles by rail north of Kaiping, a seawall and wharves were built between 1899 and 1902 to permit shipment of Kaiping coal from this port, where there was no bar as at Tangku.[46]

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438 439 This facilitation of transport, and the relatively short rail-haul from the mines to Chingwantao, were undoubtedly factors in the increased ability of Kaiping coal to compete in the Shanghai market after 1902. In the 1890's, with the assistance of French capital, another new supply of coal appeared on the east Asia market, from Indo-China. The mines, located on tidewater near Haiphong (map

* This was the Kaiping Mining Bureau, organized at the instigation of Li Hung-chang in 1878, and later (1912), after a period of British control (1901–1912), reorganized as the Kailan Mining Administration, a joint Sino-British undertaking and one of the pioneer modern industrial enterprises in China. For a valuable account of its development, see Ellsworth Carlson, *The Kailan Mines* (1949).

done with dispatch soon after Shanghai had been taken. By the end of 1949, railways destroyed in the delta area during the civil war had been restored to operation, and by the end of 1950, most of the lines in China as of 1936 had been rebuilt, plus considerable new mileage. Great stress has also been put on maintaining a high level of commodity flow by water transport from the Yangtze and the delta to Shanghai. Numerous hydraulic improvements were undertaken in 1949, 1950, and 1951, including the widening, deepening, and regulating of existing waterways, the building of additional carriers of all types,* and in November 1950 the commencement of a very large five-year project for the regulation of the Huai River, designed primarily to prevent its disastrous floods, but also to facilitate navigation.[2]

But the sea routes, equally vital to the city's economic life, remain largely closed. Political capital has been made of this unfortunate situation, since it has in effect called the Communists' bluff in their repeated assertions that Shanghai was a foreign sore on the Chinese body politic and should be integrated with China rather than with its kindred economies overseas.

> The new Shanghai . . . is closely linked by commerce and the interflow of goods with the rest of the country. Facing inland instead of across the sea, it is integrated politically, economically, and culturally with the nation whose needs it serves. From being a source of infection in China's economic life, Shanghai has today become a source of strength to the new China.[3]

This is cold comfort. Shanghai can be a source of strength to China only if it produces, and it cannot reach more than a part of its industrial potential while the sea routes which feed it are closed. The shortage of coal in the city remains, if one may read between the lines of official statements and news releases. Electric power is rationed; new users are discouraged, and one gathers that current users are unable to get enough to increase their production. Remembering the crucial importance of cheap and abundant electric power for all of the city's industry, as we have discussed it above

* 192 inland water craft were built in Shanghai alone in 1950, totalling 28,000 tons displacement, according to Ching-Chi Chou-Pao for January 4, 1951, p. 9.